CHAPTER 9
SOIL EXPOSURE PATHWAY

RESIDENT POPULATION THREAT

LIKELIHOOD OF EXPOSURE		WASTE CHARACTERISTICS		TARGETS
Observed Contamination Area with Resident Targets	X	Toxicity Hazardous Waste Quantity	X	Resident Individual Resident Population Workers Resources Terrestrial Sensitive Environments

$+$

NEARBY POPULATION THREAT

LIKELIHOOD OF EXPOSURE		WASTE CHARACTERISTICS		TARGETS
Attractiveness/ Accessibility Area of Contamination	X	Toxicity Hazardous Waste Quantity	X	Nearby Individual Population Within 1 Mile

SECTION 9.1
AREAS OF OBSERVED
CONTAMINATION

The soil exposure pathway evaluates the threat to individuals and sensitive environments of exposure to surficial contamination. The purpose of this section is to assist the scorer in identifying and delineating areas of observed contamination. It is essential to identify and delineate areas of observed contamination because:

- The pathway can be evaluated only if there are areas of observed contamination;

- Target values are assigned based on their distance from areas of observed contamination; and

- The hazardous waste quantity is based on areas of observed contamination.

The soil exposure pathway is based on current conditions; potential migration to additional targets is not evaluated. Although called the soil exposure pathway, any surficial contamination is eligible to be evaluated.

RELEVANT HRS SECTIONS

Section 2.2.2	Identify hazardous substances associated with a source
Section 2.3	Likelihood of release
Section 5.0.1	General considerations
Section 5.1.1	Likelihood of exposure
Section 5.1.2	Waste characteristics
Section 5.2.1	Likelihood of exposure

DEFINITIONS

Area of Observed Contamination: Established based on sampling locations as any of the following:

- Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.

- For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider that entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytic evidence indicates that:

- A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).

- The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).
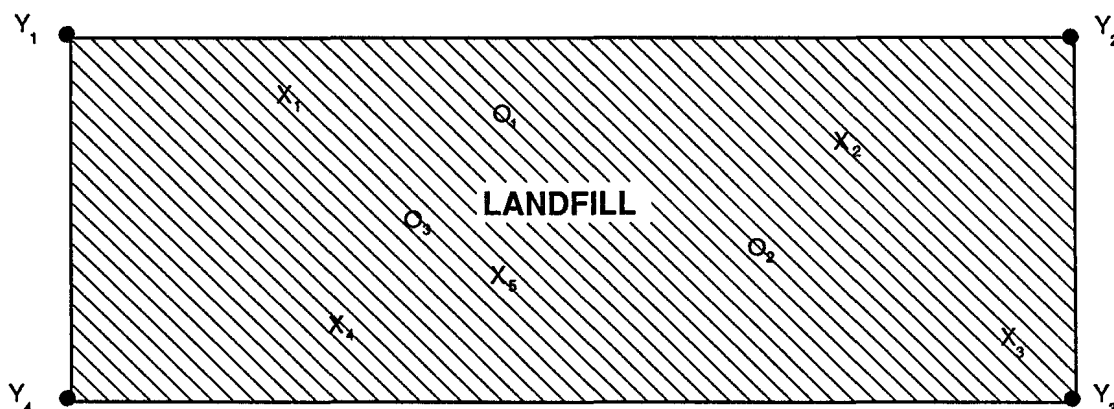
ESTABLISHING AREAS OF OBSERVED CONTAMINATION

(1) **Identify sampling locations that meet the criteria for observed contamination.** Consult *Highlight 9-1* for appropriate source-specific background samples.

(2) **Define the areas of observed contamination.**

- For all sources other than contaminated soil, consider the entire source to be an area of observed contamination if any sampling location within the source meets the criteria for observed contamination (see *Highlight 9-2*).

- For contaminated soils, consider sampling locations that meet the criteria for observed contamination and the areas lying between such sampling locations to be areas of observed contamination, unless information indicates otherwise (see *Highlights 9-3* and *9-4*).

HIGHLIGHT 9-1
BACKGROUND SAMPLES FOR AREAS OF
OBSERVED CONTAMINATION

SOURCE	Background Sample
Contaminated Soil	Soil in vicinity of the site. See Sections 5.1 and 5.2 for additional considerations.
Tanks/Drums Filled with Contaminated Soil	Same as for the soil at the site.
Tanks/Drums Containing Liquid or Solid Wastes	Background is zero.
Landfill[a]	Soil in vicinity of the site.
Piles[a]	Soil in vicinity of the site.
Surface Impoundment[a] (liquid)	Aqueous samples from vicinity of the site. Background may be zero.
Surface Impoundment[a] (sludges or backfilled)	Soil in the vicinity of the site.
Other Sources	review on a site-specific basis

[a] For these source types, the indicated sample is likely to be the most appropriate background.

HIGHLIGHT 9-2
DELINEATING AREAS OF OBSERVED CONTAMINATION FOR SOURCES OTHER THAN CONTAMINATED SOIL

Y_1 Y_2

X_1

O_1

X_2

LANDFILL

O_3

O_2

X_5

X_4

X_3

Y_4 Y_3

X_x = Sample location that establishes observed contaminiation

Y_x = Boundaries of landfill

O_x = Sample location that does not establish area of observed contamination

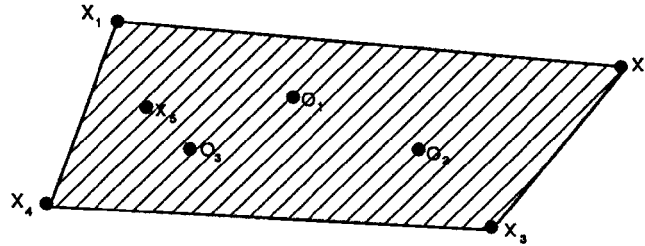Lined areas = Areas of observed contamination

Several samples indicate observed contamination, others do not. The scorer should consider the following:

• Because the landfill is a source type other than contaminated soils, and at least one sample establishes observed contamination, consider the entire landfill as the area of contamination. The area does not need to be delineated by samples.

Information that may indicate that areas lying between sampling locations do meet the criteria for observed contamination includes the following:

• The route by which hazardous substances could have migrated to areas at the site involves wide dispersion of contamination (e.g., if stack emissions are the principal mechanism of deposition, areas between sampling locations are likely to be subject to observed contamination, see *Highlight 9-5*).

• If the principal mechanism of deposition is spills (e.g., at a loading dock or process area), then generally, the entire area delineated by samples is likely to be subject to observed contamination.

• Downgradient portions of a well-defined hazardous substance migration route meet the criteria for observed contamination, even if some discrete sampling locations within the migration route do not meet the criteria.

HIGHLIGHT 9-3
DELINEATING AREAS OF OBSERVED CONTAMINATION FOR CONTAMINATED SOIL

X_x = Sample location that establishes observed contaminiation

O_x = Sample location that does not establish observed contamination

Lined areas = Areas of observed contamination

The area of observed contamination resulted from spills and is not limited to a specific area. Consider the following:

- Delineate the area of observed contamination. In this example, it would be the polygon formed by sampling locations X_1, X_2, X_3, and X_4. The left boundary of the contamination area would be X_4 to X_1 rather than X_4 to X_5 to X_1, because site-specific evaluations indicate the area to the left of X_5 may be subject to contamination.

- Include the sampling locations that do not indicate surficial contamination (e.g., O_1, O_2, and O_3) in the area of observed contamination because, based on the site operations, topography, and hazardous substance migration route, there is reason to infer these areas are subject to contamination.

(3)   **Refine areas of observed contamination.** Consider information that might indicate areas lying between sampling locations meeting the criteria for observed contamination should not be included:

- Areas are covered by a permanent or otherwise maintained, essentially impenetrable material (e.g., asphalt, concrete).

- Contamination is the result of run-off from a site, and topography indicates that certain areas within an area of contamination are on higher land and not influenced by run-off (see *Highlight 9-6*).

- The location and type of operations at a facility could preclude hazardous wastes from being in certain areas (e.g., soils near a process area and near a loading dock may be contaminated, but the area between these locations may not be expected to be contaminated).

- Cover material or fill (e.g., soil) has been deposited on top of contaminated surficial material, resulting in no observed contamination within two feet of the surface (see *Highlight 9-6*).

HIGHLIGHT 9-4
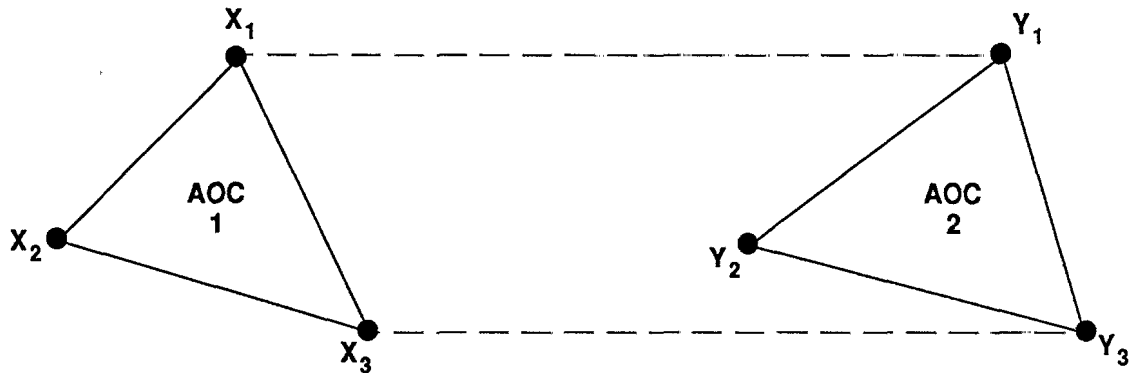## DELINEATING AREAS OF OBSERVED CONTAMINATION
USING COMPOSITE SAMPLES
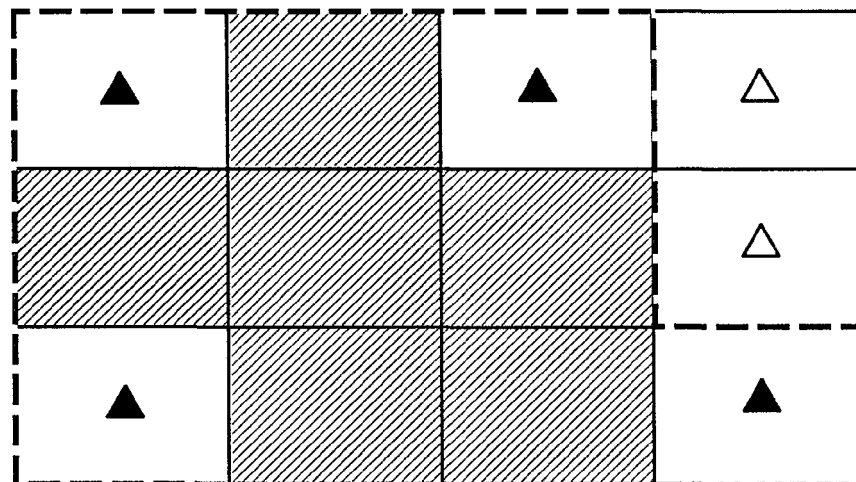
▲ Sampling grid with samples establishing observed contamination

▨ Sampling grid with inferred contamination

△ Sampling grid with samples not establishing observed contamination

Soil has been contaminated by atmospheric deposition. As part of an emergency action, extensive sampling was conducted to delineate the extent of contamination. All samples were taken within two feet of the soil surface. To delineate the area of observed contamination using the grid sampling:

- Consider each grid with a sampling location meeting the criteria for observed contamination part of the area of observed contamination.

- Consider grids with no sampling data located between grids with observed contamination (inferred or sampled) to be contaminated unless information indicates otherwise (e.g., the grid is covered by asphalt).

- Exclude grids with sampling data indicating no observed contamination.

- Exclude portions of grids that are covered by a permanent or otherwise maintained, essentially impenetrable material from the area of observed contamination.

- Therefore, the grids outlined above by the dashed line are the area of observed contamination.

HIGHLIGHT 9-5
INFERRING CONTAMINATION BETWEEN MULTIPLE
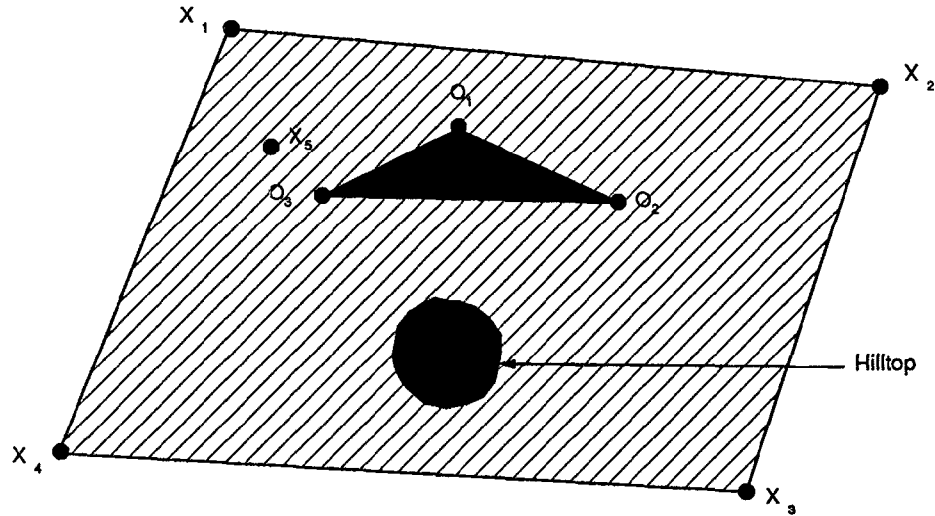## AREAS OF OBSERVED CONTAMINATION

X_x = Sample location that establishes observed contamination

Y_y = Sample location that establishes observed contamination

Two areas of observed contamination (AOC 1 and 2) are defined by sampling locations. Determine if the area between these areas can be inferred to be contaminated. Consider the following:

- If the contamination results from atmospheric deposition (e.g., releases from a smelter located in the vicinity), consider the area between AOC 1 and AOC 2 (i.e., the outlined area) to be an area of observed contamination.

- If the two areas of observed contamination are located in two separate work areas (e.g., two loading docks) and the contaminated soil results from processes performed in the work area, it may not be reasonable to infer the area between these locations to be an area of observed contamination.

- If the two areas of observed contamination are associated with different hazardous constituents and sampling data do not indicate an overlap of hazardous substances, do not include the area between these two areas of observed contamination.

HIGHLIGHT 9-6
DELINEATING AREAS OF OBSERVED CONTAMINATION WHEN UNCONTAMINATED SOILS ARE INTERMINGLED

X = Sample location that establishes observed contaminiation

O = Sample location that does not establish observed contamination

Lined areas = Areas of observed contamination

Soil has been contaminated by run-off. Areas in the center of the contamination have been disturbed and two feet of topsoil has been brought in to fill and cover an excavated area near sampling locations O_1, O_2, and O_3. In this case, consider the following:

- Delineate the area of observed contamination as the polygon formed by sampling locations X_1, X_2, X_3, and X_4. The left boundary of the contaminated area would be X_4 to X_1 rather than X_4 to X_5 to X_1, because site-specific evaluations indicate the area to the left of X_5 may be subject to contamination.

- Delineate the area marked by the samples indicating no surficial contamination. In this example, two or more feet of topsoil has been deposited in the vicinity of sampling locations O_1, O_2 and O_3 to fill an excavated area. Because the topsoil was deposited in this area and analytic samples indicate no observed contamination, assume the surficial soil is not contaminated in this area.

- Since the hilltop is not in the hazardous substance migration route (i.e., it is at a higher elevation and the run-off flows around the hill), do not consider the hilltop subject to observed contamination (samples are not necessary in this situation).

- Subtract the area of no observed contamination (i.e., the area marked by samples and the hilltop) from the total area of observed contamination to determine the actual area of observed contamination.

TIPS AND REMINDERS

- Score the soil exposure pathway only if observed contamination is established.

- Analytic evidence supported with non-sampling evidence may be used to infer the extent of observed contamination. Non-sampling evidence may include soil staining, documented historical waste deposition patterns, stressed vegetation patterns, and data derived from investigations such as soil gas surveys.

- An area of observed contamination can be defined by one sampling location. For example, one sample is collected from a residential property to which site-related contamination has migrated.

- Contaminated samples from leachate and sediments can be used to document observed contamination if they are attributable to the site, and for sediments, if they are not covered by water at all times.

SECTION 9.2
WASTE CHARACTERISTICS
FOR THE SOIL EXPOSURE
PATHWAY

WC
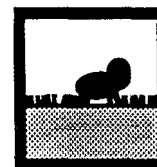
This section compares the differences in evaluating toxicity and hazardous waste quantity for the soil exposure pathway and the migration pathways. (For guidance on evaluating hazardous waste quantity for the migration pathways, see Chapter 6.)

Because the soil exposure pathway assesses the risks associated with exposure to existing surficial contamination, evaluation of waste characteristics for the soil exposure pathway differs from the evaluation for the migration pathways. There are differences in both the contaminant characteristics and the hazardous waste quantity components of waste characteristics. In evaluating contaminant characteristics, only substances that establish observed contamination can be used (e.g., do not use any other hazardous substance in the source). Furthermore, toxicity is the only contaminant characteristic included in the soil exposure pathway; other factors such as mobility and persistence are not considered.

This section details differences in the evaluation of hazardous waste quantity. In general, the evaluation performed for the migration pathways is modified to include only hazardous waste present in the top two feet of surficial matter. Thus, several divisors in the default equations are different (i.e., HRS Table 5-2 is used instead of HRS Table 2-5). Although termed the "soil exposure" pathway, all sources on which areas of observed contamination are established can be included in the site hazardous waste quantity factor value.

```
                     RELEVANT HRS SECTIONS

Section 2.2.2            Identify hazardous substances associated with a source
Section 2.4.1.1          Toxicity factor
Section 2.4.2            Hazardous waste quantity
Section 5.1.2.1          Toxicity
Section 5.1.2.2          Hazardous waste quantity
Section 5.2.1.2          Area of contamination
Section 5.2.2.1          Toxicity
```

DEFINITIONS

Area of Observed Contamination: Established based on sample locations as any of the following:

•   Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.

- For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider that entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytic evidence indicates that:

- A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).

- The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).

EVALUATING TOXICITY

Select the hazardous substance with the highest human toxicity factor value from among the substances that meet the criteria for observed contamination for the threat evaluated. In addition, for the nearby threat, the substance must also be from an area with an attractiveness/accessibility factor value greater than zero.

Assign a toxicity factor value for a hazardous substance in the soil exposure pathway the same as for any other pathway (except the surface water environmental threat). The process, described in HRS section 2.4.1.1 and presented in HRS Table 2-4, is based on this hierarchy:

- Chronic toxicity using RfDs/carcinogenicity using SFs and weight-of-evidence ratings; and, if these are not available,

- Acute toxicity using LD_{50}s and LC_{50}s.

Both PREscore and SCDM can help determine the toxicity value of a particular hazardous substance. See HRS section 2.4.1.1 for detailed direction in obtaining toxicity values and assigning a toxicity factor value for hazardous substances not included in PREscore or SCDM.

EVALUATING HAZARDOUS WASTE QUANTITY

Primary differences in evaluating hazardous waste quantity in the soil exposure pathway compared to the migration pathways, include the following:

- Only areas of observed contamination are considered.

- Only the first two feet of depth of an area of observed contamination are considered (except as specified for volume measures).

- Areas covered by essentially permanent, impenetrable material are excluded (e.g., contaminated soil covered by uncontaminated asphalt).

- Tier C (volume) can be used only for drums, tanks and containers other than drums, and surface impoundments containing liquid hazardous substances.

- Some equations for assigning a source hazardous waste quantity value in Tier D are different (Note that, if available, Tier A and B data can also be used for drums, tanks, and surface impoundments).

- If Tier A is not adequately determined, the minimum factor value is always 10.

These differences are summarized in *Highlight 9-7.*

EVALUATING TIER A — HAZARDOUS CONSTITUENT QUANTITY

To evaluate Tier A for an area of observed contamination:

(A1) **Determine whether the source Is an area of observed contamination.** See Section 9.1. For the nearby population threat, also determine if the area of observed contamination has an attractiveness/accessibility factor value greater than 0 (see Section 9.8). If not, do not evaluate hazardous waste quantity for that particular area of observed contamination.

(A2) **Determine whether CERCLA hazardous substances meet the criteria for observed contamination (i.e., attributable to the site, present at a concentration significantly above background levels, and present within 2 feet of the surface).**

For each area of observed contamination, consider only those hazardous substances that meet the criteria for observed contamination within that area (e.g., if substance X meets the criteria for observed contamination in Source A, it cannot be evaluated in Source B unless it also meets the criteria for observed contamination in Source B);

- If there are such substances, continue to Step (A3).

- If not, do not evaluate the area of observed contamination with Tier A. Assign a value of zero for source hazardous constituent quantity and evaluate the area of observed contamination with Tier B.

(A3) **Evaluate the area of observed contamination using Tier A In the same manner as for migration pathways.** See Section 6.2. There are two exceptions to this evaluation:

- Consider only the top two feet of the area of observed contamination, based on present conditions at the site.

- Assign a value for the area of observed contamination using the Tier A equation in HRS Table 5-2 (Note the Tier A equation is identical in HRS Tables 5-2 and 2-5).

Hazardous substance concentration data that is representative of the top two feet of an area of observed contamination may be used.

EVALUATING TIER B — HAZARDOUS WASTESTREAM QUANTITY

To evaluate Tier B for an area of observed contamination in the soil exposure pathway:

(B1) **Determine whether the source Is an area of observed contamination.** See Section 9.1. For the nearby population threat, also determine if the area of observed contamination has an attractiveness/accessibility factor value greater than 0 (see Section 9.8). If not, do not evaluate hazardous waste quantity for that particular area of observed contamination.

HIGHLIGHT 9-7
COMPARISON OF HAZARDOUS WASTE QUANTITY
EVALUATION IN THE MIGRATION PATHWAYS AND
THE SOIL EXPOSURE PATHWAY

Migration Pathways	Soil Exposure Pathway
Evaluate all sources.	Evaluate only areas of observed contamination.
Consider entire source when evaluating all four tiers.	Consider only top two feet of an area of observed contamination, except when evaluating Tier C (volume).

Tier C (volume) can be used for these types of sources:
 	
    Landfill
    Surface impoundment
    Surface impoundment (buried/backfilled)
    Drums
    Tanks and containers other than drums
    Contaminated soil
    Pile
    Other
	Tier C (volume) can be used only for these types of sources:
	
	    Surface Impoundment containing
	     hazardous substances present as liquids
	    Drums
	    Tanks and containers other than drums

Table 2-5 provides the equations for assigning the source hazardous waste quantity value.	Table 5-2 provides the equations for assigning the source hazardous waste quantity value.
If hazardous constituent quantity (Tier A) Is not adequately determined for all sources, the minimum factor value depends on: • Whether the targets are subject to actual contamination, and • Whether there has been a removal action.	If hazardous constituent quantity (Tier A) is not adequately determined for all areas of observed contamination, the minimum factor value is always 10.

(B2) **Determine whether Tier A has been adequately determined for the area of observed contamination.** If so, do not evaluate Tiers B, C, or D for this area. If Tier A is not adequately determined, continue to Step (B3).

(B3) **Determine If the hazardous wastestream contains hazardous substances that meet the criteria for observed contamination (i.e., attributable to the site, present at a concentration significantly above background levels, and present within 2 feet of the surface).** Only hazardous wastestreams that contain at least one hazardous substance that meets the criteria for observed contamination within an area of observed contamination are considered present in that area of observed contamination.

    • Do not evaluate those wastestreams, that do not contain at least one hazardous substance that meets the criteria for observed contamination.

    • If no wastestreams contain hazardous substances that meet the criteria for observed contamination do not evaluate the area of observed contamination with Tier B. Assign

a value of 0 for source hazardous wastestream quantity and evaluate the area of contamination with Tier C.

- If wastestreams contain hazardous substances that meet the criteria for observed release, continue to Step (B4).

(B4) **Evaluate the area of observed contamination using Tier B in the same manner as for the migration pathways**. See Section 6.3. There are two exceptions:

- Consider only the top two feet of the area of observed contamination, based on present conditions at the site.

- Assign a value for the area of observed contamination using the Tier B equation in HRS Table 5-2. (Note the Tier B equation is identical in HRS Tables 5-2 and 2-5.)

Manifests and process records usually provide good accounts of wastestreams. However, since the evaluation of hazardous wastestreams in the soil exposure pathway is restricted to the top two feet of the area of observed contamination and is based on present conditions, it should be documented that the waste, reported in the manifests and process records, was deposited or migrated within the top two feet. As general guidance, if manifests specify how much waste was deposited into a landfill and the landfill is known to be, for example, 10 feet deep, then 24/10 (or 1/5) of the manifested wastestream quantity can be assumed to be within the top two feet, unless information indicates otherwise.

EVALUATING TIER C — VOLUME

To evaluate Tier C for an area of observed contamination in the soil exposure pathway:

(C1) **Determine whether the source Is an area of observed contamination.** See Section 9.1. For the nearby population threat, also determine if the area of observed contamination has an attractiveness/accessibility factor value greater than 0 (see Section 9.8). If not, do not evaluate hazardous waste quantity for that particular area of observed contamination.

(C2) **Determine whether Tier A or B has been adequately determined for the area of observed contamination.** If so, do not evaluate Tier C or D for this area. If Tier A or B is not adequately determined, continue to Step (C3).

(C3) **Determine It the type of area of observed contamination Is eligible to be evaluated under Tier C in the soil exposure pathway.**

- Use Tier C only for the following types of areas of observed contamination:

    S   Surface impoundments containing hazardous substances present as liquids (evaluate dry, buried or backfilled surface impoundments under Tier D);

    S   Drums; or

    S   Tanks and containers other than drums.

    If the area of observed contamination is eligible to be evaluated under Tier C, continue to Step (C4).

- If not, do not evaluate the area of observed contamination with Tier C. Assign a value of 0 for source volume, and evaluate the area of contamination using Tier D.

(C4) **In evaluating volume for the eligible types of areas of observed contamination, use the <u>full</u> volume, not just the volume within the top two feet.** Evaluate the area of observed contamination using Tier 0 in the same manner as for migration pathways (see Section 6.4) except:

- Assign a value for the area of observed contamination using the Tier C equation in HRS Table 5-2.

EVALUATING TIER D — AREA

To evaluate Tier D (area), for an area of observed contamination not eligible to be evaluated under Tier C (volume):

(D1) **Determine whether the source Is an area of observed contamination.** See Section 9.1. For the nearby population threat, also determine if the area of observed contamination has an attractiveness/accessibility factor value greater than 0 (see Section 9.8). If not, do not evaluate hazardous waste quantity for that particular area of observed contamination.

(D2) **Determine whether Tier A, B, or C has been adequately determined for the area of observed contamination.** If so, do not evaluate Tier D. If Tier A, B, or C is not adequately determined, continue to Step (D3).

(D3) **Determine If the area of contamination Is one of the following:**

- Surface impoundments containing hazardous substances present as liquids (evaluate dry, buried or backfilled surface impoundments under Tier D);

- Drums; or

- Tanks and containers other than drums.

If the area of contamination is one of these three types, evaluate using Tier C. Do not evaluate using Tier D.

If the area of contamination is not one of these three types, continue to Step (D4).

(D4) **Evaluate the area of observed contamination using Tier D In the same manner as for migration pathways.** See Section 6.5. There is one exception:

- Assign a value for the area of observed contamination using the Tier D equations in HRS Table 5-2.

CALCULATING HAZARDOUS WASTE QUANTITY FACTOR VALUE

Select the highest of the values assigned to each area of observed contamination from all tiers evaluated. This value is the source hazardous waste quantity for the area of observed contamination.

Sum the source hazardous waste quantity values assigned to each area of observed contamination to determine the hazardous waste quantity factor value. Round this sum to the nearest integer, except if the sum is greater than 0, but less than 1, then round it to 1. Based on this value, select the hazardous waste quantity factor value for the soil exposure pathway using HRS Table 2-6.

The minimum hazardous waste quantity factor value for the soil exposure pathway is 10, unless Tier A is adequately determined, regardless of whether targets are actually contaminated or whether a qualifying removal action has taken place.

TIPS AND REMINDERS

- The hazardous waste quantity value calculated for the resident population threat will be equal to or greater than the hazardous waste quantity value calculated for the nearby population threat. This is because of the additional requirement that only areas of observed contamination with an attractiveness/accessibility factor value greater than 0 can be evaluated for the nearby population threat.

- Use available volume measurements for surface impoundments containing hazardous substances as liquids, drums, and other containerized wastes. Otherwise, use the area measure of the upper two feet for all sources.

- Consider only substances that meet the criteria for observed contamination when calculating waste characteristics.

SECTION 9.3
RESIDENT
POPULATION THREAT
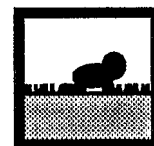
This section provides an overview of the targets factor category of the resident population threat of the soil exposure pathway and explains how to identify targets for that threat.*Highlight 9-8* summarizes the targets considered in the resident population threat, the maximum factor value assigned to each of these targets, and references to the sections of this guidance and the section in the HRS that discuss each target. All targets evaluated in the resident population threat are subject to actual contamination. If no targets are identified, the resident population threat receives a score of 0; however, the nearby population threat may still be evaluated.

RELEVANT HRS SECTIONS

Section 5.1.3	Targets
Section 5.1.3.1	Resident individual
Section 5.1.3.2	Resident population
Section 5.1.3.3	Workers
Section 5.1.3.4	Resources
Section 5.1.3.5	Terrestrial sensitive environments

HIGHLIGHT 9–8
TARGETS IN THE RESIDENT POPULATION THREAT

Target	Maximum Factor Value	HRSGM Section	HRS Section
Resident Individual	50	9.4	5.1.3.1
Resident Population	no maximum	9.4	5.1.3.2
Workers	15	9.5	5.1.3.3
Resources	5	9.6	5.1.3.4
Terrestrial Sensitive Environment	site-specific-limited to that which results in a pathway score of 60 based solely on sensitive environments	9.7	5.1.3.5

DEFINITIONS

Area of Observed Contamination: Established based on sampling locations as any of the following:

• Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.

• For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider that entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytic evidence indicates that:

• A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).

• The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).

Resident Individual: A person who lives or attends school or day care on a property with an area of observed contamination and whose residence, school, or day care center, respectively, is on or within 200 feet of the area of observed contamination.

Resources: Resources considered for the soil exposure pathway are commercial agriculture, commercial silviculture, and commercial livestock production or grazing. Resources must be located on an area of observed contamination. See Section 9.5 for additional guidance.

Students: Full- or part-time attendees of an educational institution or day care facility located on or within 200 feet of an area of observed contamination. That area must also be within the property boundaries of institution of facility.
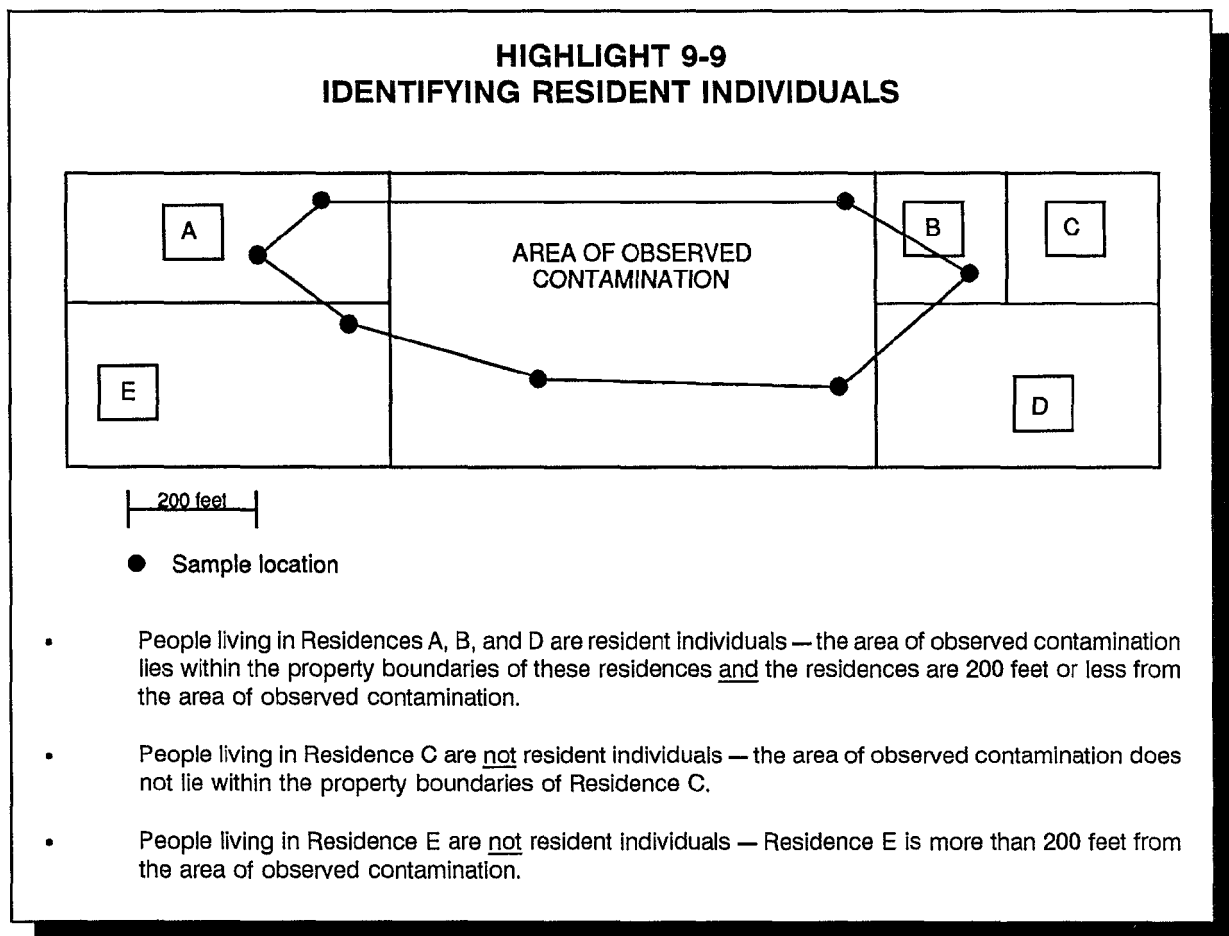
Terrestrial Sensitive Environment: A terrestrial sensitive environment is defined as any area that meets the criteria listed in HRS Table 5-5. No other areas are considered terrestrial sensitive environments. Appendix A defines each terrestrial sensitive environment and provides sources for identifying terrestrial sensitive environments. See Section 9.6 for additional guidance on scoring terrestrial sensitive environments.

Worker: A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered. Section 9.5 provides additional guidance.

IDENTIFYING RESIDENT INDIVIDUALS AND WORKERS

Identify resident individuals and workers as follows (see*Highlight 9-9* for an example):

(1)   **Delineate areas of observed contamination.** Section 9.1 provides step-by-step instructions for delineating areas of observed contamination. Mark these areas on a map that also indicates property boundaries (usually legal boundaries are the most appropriate) in the vicinity of the site.

(2)   **Identify those properties with areas of observed contamination.** If an area of observed contamination is located within the property boundaries of a residential property, school/day-care center, or workplace, continue to Step (3).

(3)   **Determine whether the residence, school, day care center, or workplace is within 200 feet of an area of observed contamination.**

*   Measure this distance as a straight line from the part of the building nearest the area of observed contamination unless there is a major obstacle (e.g., building, fence) between the two points. If the residence, school, day care center, or workplace area is within 200 feet of an area of observed contamination, then the resident, student, day care attendee, or worker is a target for the resident population threat. If the distance is greater than 200 feet, then those persons are <u>not</u> targets for the resident population threat.

**HIGHLIGHT 9-9
IDENTIFYING RESIDENT INDIVIDUALS**

├─── 200 feet ───┤

● Sample location

*   People living in Residences A, B, and D are resident individuals — the area of observed contamination lies within the property boundaries of these residences <u>and</u> the residences are 200 feet or less from the area of observed contamination.

*   People living in Residence C are <u>not</u> resident individuals — the area of observed contamination does not lie within the property boundaries of Residence C.

*   People living in Residence E are <u>not</u> resident individuals — Residence E is more than 200 feet from the area of observed contamination.

Section 9.3

- Evaluate multiple-unit residences such as apartments and condominiums as follows:

    — If the area of observed contamination is located in a common area, count all residents that regularly use the area as resident individuals, regardless of the distance from the area of observed contamination to the individual residences (e.g., if an apartment has four playgrounds, count 1/4 of the residents for each playground).

    — If the entire area of observed contamination is located in private areas (e.g., individual backyards), count only those residents living within 200 feet of the area of observed contamination as resident individuals.

IDENTIFYING RESOURCES AND TERRESTRIAL SENSITIVE ENVIRONMENTS

(1) **Delineate areas of observed contamination.** Section 9.1 provides step-by-step instructions for delineating areas of observed contamination. Mark these areas on a scale map or diagram.

(2) **Identify resources or terrestrial sensitive environments present on an area of observed contamination.**

- If one of the designated resource uses (see Section 9.5) is on an area of observed contamination, that use is a target for the resources factor.

- If one of the terrestrial sensitive environments listed in HRS Table 5-5 is on an area of observed contamination, that terrestrial sensitive environment is a target for the resident population threat.

Resources or terrestrial sensitive environments must be on an area of observed contamination to be scored; if they are within 200 feet, but not <u>on</u> an area of observed contamination, they cannot be scored.

LEVEL I AND LEVEL II CONCENTRATIONS

Evaluate only targets subject to actual contamination in the resident population threat; do not evaluate targets subject to potential contamination. For resident individuals (i.e., residents, students, and children attending day care), the scorer should determine whether the targets are subject to Level I or Level II concentrations (see Section 9.4). <u>Workers, terrestrial sensitive environments, and resources are not differentiated by Level I and Level II.</u>

TIPS AND REMINDERS

- Assuming a maximum value for waste characteristics, a site can score greater than 28.50 based on the soil exposure pathway resident population if:

    — Four resident individuals are exposed to Level I concentrations; or
    — 41 resident individuals are exposed to Level II concentrations.

- If no resident individuals are identified, do not determine it the observed contamination is at Level I concentrations or Level II concentrations.

SECTION 9.4
RESIDENT INDIVIDUAL
AND RESIDENT
POPULATION

This section provides instructions for determining the level of contamination for resident individuals, and scoring resident individual and resident population factors in the soil exposure pathway. The resident individual and resident population factors are two components used to score the targets factor category of the resident population threat. The scorer should consider the number of qualifying residents on or near the area of observed contamination, and determine if they are subject to Level I or Level II concentrations.

RELEVANT HRS SECTIONS

Section 5.1.3   Targets
Section 5.1.3.1   Resident individual
Section 5.1.3.2   Resident population

DEFINITIONS

Resident Individual: A person who lives or attends school or day care on a property with an area of observed contamination <u>and</u> whose residence, school, or day care center, respectively, is on or within 200 feet of the area of observed contamination. Section 9.3 provides guidance for identifying resident individuals.

Resident Individual Subject to Level I Concentrations: A resident individual is subject to Level I concentrations if the concentration of a hazardous substance that meets the criteria for observed contamination is <u>at or above</u> the appropriate benchmark and the sampling location is within the property boundary and within 200 feet of the residence/school. Level I concentrations also may be established if multiple hazardous substances are present below their respective benchmarks, but the I or J index is greater than or equal to one. Benchmarks for the soil exposure pathway include screening concentrations for cancer and screening concentrations for chronic noncancer effect.

Resident Individual Subject to Level II Concentrations: A resident individual not subject to Level I concentrations.

Resident Population: Total number of people meeting the criteria for resident individual.

Students: Full- or part-time attendees of an educational institution or day care facility located on or within 200 feet of an area of observed contamination. That area must also be within the property boundaries of the institution or facility.

Worker: A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered. Section 9.5 provides additional guidance.

EVALUATING LEVEL OF CONTAMINATION

To score the resident individual and resident population factors, the scorer should first determine the areas of observed contamination (see Section 9.1) and identify all resident individual targets (see Section 9.3). (Do not count workers in the resident individual or resident population factors. Section 9.5 describes how to score workers in the soil exposure pathway.) Next, determine whether each target is subject to Level I or Level II concentrations. Finally, evaluate the resident individual and resident population factors.

All resident individuals identified as targets for the resident population threat will be either at Level I or Level II. No targets in the resident population threat are evaluated as subject to potential contamination.

(1) **Identify sampling locations that meet the criteria for observed contamination.** See Section 9.1.

(2) **Determine the level of contamination for each sampling location.** Compare the concentration of each hazardous substance that meets the observed contamination criteria for that sampling location with its benchmark(s) for the soil exposure pathway. These benchmarks are available in SCDM.

  •   If the concentration of any one of these hazardous substances is greater than or equal to its benchmark, that sampling location is Level I. Go to Step (4).

  •   If only one hazardous substance meets the criteria for observed contamination and its concentration is less than the benchmark, that sampling location is Level II. Go to Step (4).

  •   If more than one hazardous substance meets the observed contamination criteria for that sampling location but no single substance by itself can be used to establish Level I, continue to Step (3).

(3) **Calculate the I and J indices for all hazardous substances that meet the observed contamination criteria.** Make two lists of substances that meet the observed contamination criteria: (1) hazardous substances with screening concentrations for cancer risk and (2) hazardous substances with screening concentrations for noncancer effects. Each hazardous substance may be on one, neither, or both of the lists. If more than one sample has been taken at a sampling location and these samples are comparable (e.g., taken in the same time frame, collected using the same field techniques, analyzed by the same methods) for each hazardous substance, select the highest concentration to use in the calculations below.

  •   Calculate the I index for all hazardous substances with screening concentrations for cancer risk that meet the observed contamination criteria for that sampling location, using the following equation:

$$I = \sum_{i=1}^{n} \frac{C_i}{SC_I}$$

where: C_i = concentration of hazardous substance i at sampling location;

SC$_i$ = screening concentration for cancer corresponding to a concentration associated with a risk of 10^6 from oral exposure for hazardous substance i; and

n = total number of hazardous substances that meet observed contamination criteria; that are carcinogens; and for which an SC is available.

• Calculate the J index for all hazardous substances with screening concentrations for noncancer effects that meet the observed contamination criteria, using the following equation:

$$ J = \sum_{j=1}^{m} \frac{C_j}{CR_j} $$

where: C_j = concentration of hazardous substance j at sampling location;

CR_j = screening concentration for noncancer effects corresponding to oral exposure at reference dose for hazardous substance j; and

m = number of hazardous substances that meet observed contamination criteria and for which a CR is available.

• If either the I or J index is greater than or equal to 1, the sampling location is Level I. If both the I and J indices are less than 1, the sampling location is Level II.

(4) **Indicate on the site map(s) (with property boundaries marked) where areas of observed contamination have been delineated and Identify each sampling location as Level I or Level II.**

(5) **Identify targets subject to Level I concentrations.** For each resident individual (see Section 9.3), determine whether a Level I sampling location is located within the property boundaries and within 200 feet of the residence, school, or day care center. If so, evaluate the target as Level I. Remember, an inferred area of observed contamination between Level I sampling locations is generally evaluated as Level II. If Level I concentrations cannot be established, continue to Step (6).

(6) **Identify targets subject to Level II concentrations.** All resident individuals not subject to Level I concentrations are subject to Level II concentrations.

EVALUATING RESIDENT INDIVIDUAL

Evaluate this factor based on whether a resident individual, as specified above, is subject to Level I or Level II concentrations. Assign a value to the resident individual factor as follows:

• Assign a value of 50 if at least one resident individual is subject to Level I concentrations.

• Assign a value of 45 if no resident individual is subject to Level I concentrations, but at least one resident individual is subject to Level II concentrations.

• Assign a value of 0 if no resident individual is identified.

Section 9.4

EVALUATING RESIDENT POPULATION

The resident population factor value is scored based on the number of resident individuals subject to Level I and Level II concentrations. The Level I and Level II concentration factor values are summed to calculate the resident population factor value.

Evaluate properties that have been subdivided as follows: if a subdivision consists of individual lots that are owned by the residents, then treat them as individual properties. If the individual lots are rented by the individuals living on them, but are still owned by one separate entity (e.g. a trailer park), treat them as one common property.

(1)   **Evaluate the Level I concentration factor.**

- Determine the total number of resident individuals subject to Level I concentrations. Take an exact count or multiply the number of residences by the average number of people per residence for that county. This number should reflect the number of resident individuals at the time of SI scoring. However, if a residence or school was abandoned for reasons related to site contamination, use the population at the time it was abandoned.

- Calculate the Level I concentration factor value. Multiply the number of persons subject to Level I concentrations by 10 to calculate the factor value. Round the number to the nearest integer.

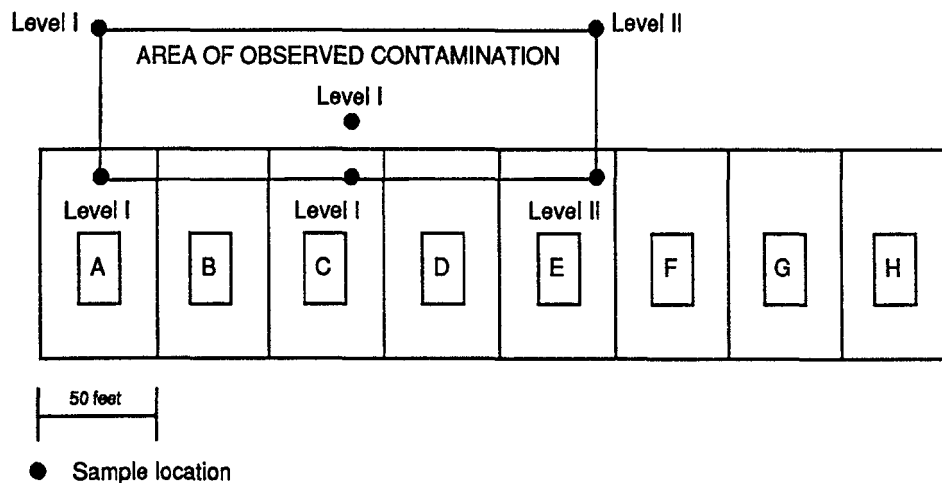(2)   **Evaluate the Level II concentration factor.**

- Determine the total number of resident individuals subject to Level II concentrations. Determine as indicated in Step (1). Do not include anyone already counted in the Level I concentration factor.

- Calculate the Level II concentration factor value. The number of persons subject to Level II concentrations is the Level II concentration factor value. Round the number to the nearest integer.

(3)   **Calculate the resident population factor value.** Sum the factor values for Levels I and II concentrations. This number is the resident population factor value.

Highlights 9-10 and *9-11* provide examples of determining the level of contamination, scoring the resident individual factor value, and scoring the resident population factor value.

HIGHLIGHT 9-10
SCORING EXAMPLE FOR RESIDENT POPULATION
ON ADJACENT PROPERTIES

This example illustrates how to determine whether targets are subject to Level I or Level II concentrations and how to score the resident individual and resident population factors for several residences on individual properties located adjacent to the site.

Level I ●————————————————● Level II
AREA OF OBSERVED CONTAMINATION
Level I
●

Level I		Level I		Level II			
A	B	C	D	E	F	G	H

| 50 feet |

● Sample location

(1) **Determine the level of contamination.**

- People living in residences A and C are subject to Level I concentrations because their residence is within 200 feet of a Level I sample on their property.

- People living in residence B are subject to Level II concentrations because their residence is within 200 feet of an inferred area of contamination on their property.

(2) **Assign points for the resident individual factor.** In this example, assign a value of 50, because at least one resident individual is subject to Level I concentrations.

(3) **Evaluate the resident population factor.**

- The 8 people living in residences A and C are subject to Level I concentrations. Level I concentration factor value = **8 x 10 = 80**

- The 3 people living in residence B are subject to Level II concentrations. Level II concentration factor value = **3**

- Sum the Level I and Level II values to obtain the resident population factor value, . Resident population factor value = **80 + 3 = 83**

HIGHLIGHT 9-11
SCORING EXAMPLE FOR MULTIPLE RESIDENCES ON ONE PROPERTY

This example illustrates how to determine whether targets are subject to Level I or Level II concentrations, and how to score the resident individual and resident population factors for a single property containing a number of residences (e.g., trailers). All residences in the figure below are within one property boundary.
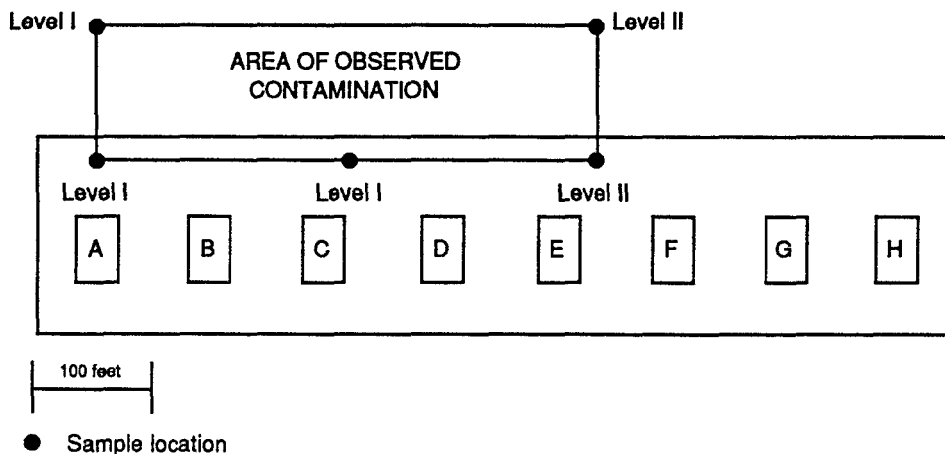
(1) **Determine the level of contamination.**

- People living in residences A, B, C, D, and E are subject to Level I concentrations because they are within 200 feet of a Level I sample on their property.

- People living in residences F and G are subject to Level II concentrations because F and G are within 200 feet of a Level II sampling point on their property, but not within 200 feet of a Level I sampling point.

- People living in residence H are not evaluated as resident individuals because H is not within 200 feet of an area of observed contamination.

(2) **Assign points for the resident individual factor.** In this example, assign a value of 50, because there is at least one resident individual subject to Level I concentrations.

(3) **Evaluate the resident population factor.**

- The 18 people living in residences A, B, C, D, and E are subject to Level I concentrations. Level I concentration factor value = **18 x 10 = 180**

- The 8 people living in residences F and G are subject to Level II concentrations. Level II concentration factor value = **8**

- Sum the Level I and Level II values to obtain the resident population factor value. Resident population factor value = **180 + 8 = 188**

TIPS AND REMINDERS

- Evaluate and document the resident population factor accurately because a relatively small increase in the number of targets can significantly affect the site score.

- Because individuals can be exposed both at home and at school, count a student twice if that student attends school and resides within 200 feet of an area of observed contamination on a property with an area of observed contamination. Count teachers who both live <u>and</u> work in such areas once in the resident population factor value and once in the worker factor value (see Section 9.5).

- A property can be inferred to have observed contamination if the property lies between points of observed contamination, unless information indicates otherwise. Level I concentrations, however, generally should not be inferred across property boundaries.

- Do not count transient populations such as customers and travelers passing through the area.

- When scoring a school population for the resident threat, score teachers as workers and score students (including college students) as resident individuals if the school is on a property with an area of observed contamination and the school is within 200 feet of the area of observed contamination.

- If individuals abandoned schools, homes, or workplaces for reasons related to site contamination, score these individuals as targets in the appropriate factor. If the individuals abandoned their schools, homes, or workplaces for reasons other than the site contamination, do <u>not</u> score the individuals as targets.

SECTION 9.5 WORKERS AND RESOURCES
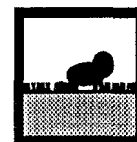
This section provides guidance for evaluating workers and scoring the resources factor for the targets factor category in the resident population threat of the soil exposure pathway. The workers factor is used to score the targets factor category of the resident population threat. The scorer must consider the number of workers who frequent workplace areas on or near the area of observed contamination. The resources factor evaluates the possible loss of resource use resulting from surficial contamination at a site. The factor evaluates the presence of commercial agriculture, commercial silviculture, commercial livestock production, and commercial livestock grazing; it does not evaluate threats to human health or sensitive environments.

RELEVANT HRS SECTION

Section 5.1.3	Targets
Section 5.1.3.3	Workers
Section 5.1.3.4	Resources
Section 5.1.3.6	Calculation of resident population targets factor category value

---

DEFINITIONS

Commercial Agriculture: Production of crops for sale, including crops intended for widespread distribution (e.g., supermarkets) and more limited distribution (e.g., local produce stands), and any nonfood crops such as cotton and tobacco. Commercial agriculture does not include livestock production, livestock grazing, or crops grown for household consumption (e.g., backyard garden or fruit trees).

Commercial Livestock Production or Commercial Livestock Grazing: Raising or feeding of livestock for sale.

Commercial Silviculture: Cultivation of trees for sale (e.g., Christmas tree farm, trees raised for lumber).

Worker: A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered.

Workplace Area: Any area where workers are regularly present. Areas receiving only brief but regular use (e.g., parking areas, lunch areas) may qualify as work areas.

EVALUATING THE WORKERS FACTOR

Workers are <u>not</u> resident individuals and therefore cannot be used to score either the resident individual or resident population factors. Workers <u>can</u> be used to score the workers factor of the resident population threat as long as their workplace qualifies as an area of observed contamination. *Highlight 9-12* provides an example of scoring workers in the soil exposure pathway. Follow the steps below to score the workers factor.

(1) **Identify areas of observed contamination.** Section 9.1 provides detailed instructions for identifying areas of observed contamination.

(2) **Determine which groups of workers have workplace areas within 200 feet of the area of observed contamination.** Refer to facility maps and descriptions of job responsibilities.

(3) **Evaluate the workers factor value based on the number of workers that meet the criteria above.** Contact the workplace directly, remembering that the factor value is assigned based on broad ranges of numbers. Thus, it is not necessary to obtain an exact count of workers.

(4) **Assign a value for these workers using HRS Table 5-4.**

HIGHLIGHT 9-12
EVALUATING WORKERS AT A MULTIPLE-BUILDING FACILITY

This example illustrates how to evaluate workers at a facility with more than one workplace area.
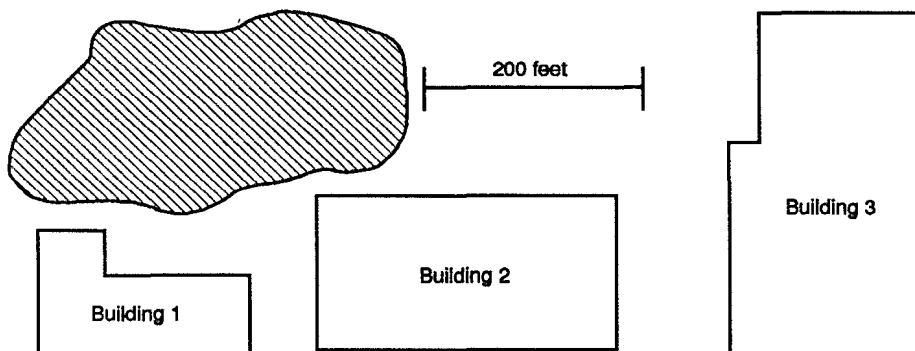
Building 1 has approximately 50 workers, Building 2 has approximately 125 workers, and Building 3 has approximately 250 workers. All the buildings and the area of observed contamination are within the same property boundary.

Count workers in Buildings 1 and 2 as targets in the soil exposure pathway. Do not count workers in Building 3 because they do not work within 200 feet of the area of observed contamination and are not expected to frequent Buildings 1 or 2 on a regular basis.

The total number of qualifying workers is 175. Assign the workers factor a value of 10, using HRS Table 5-9.

SCORING THE RESOURCES FACTOR

(1) **Determine if any land uses for which resource points are assigned are located on areas of observed contamination.** See *Highlight 9-13.* Use the definitions above in making this determination. The resource use must be <u>within the boundary</u> of the area of observed contamination. *Highlight 9-14* provides sources of information that may help document resources at the site.

(2) **If a resource use Is documented, assign a value of 5 to the resources factor for the site.** If no resource use is documented, assign a value of 0.

HIGHLIGHT 9-13
CHECKLIST FOR THE RESOURCES FACTOR

For the site being evaluated:

(1) Is commercial agriculture present on an area of observed contamination at the site?   Yes   No

(2) Is commercial silviculture present on an area of observed contamination at the site?   Yes   No

(3) Is commercial livestock production or commercial livestock grazing present on an area of observed contamination at the site?   Yes   No

If the answer is "yes" for <u>any</u> of the possibilities above, assign a resources factor value of 5. Otherwise, assign a resources factor value of 0. Remember that "yes" should be circled only if an activity takes place <u>on</u> an area of observed contamination.

HIGHLIGHT 9-14
DATA SOURCES FOR THE RESOURCES FACTOR

The following sources of information may help in documenting resource use for a site:

- **Agricultural extension agents**
- **Correspondence with nearby businesses**
- **Correspondence with other nearby institutions, such as farms or universities**
- **County land use maps**
- **PA/SI reports**
- **Field observations**
- **Files from adjacent or nearby CERCLIS sites**
- **Local chambers of commerce**
- **Soil Conservation Service State departments of natural resources or state environmental departments, especially forestry departments**
- **The U.S. Department of Agriculture/U.S. Forest Service**
- **Topographic maps.**

TIPS AND REMINDERS

- Likelihood of exposure rather than duration is the important factor in determining if an individual may be exposed to hazardous substances at a workplace area. For example, workers who frequent a lunch area or administrative building located within 200 feet of an area of observed contamination may be counted as workers, even if their "regular" workplace area is more than 200 feet from the area of observed contamination.

- When evaluating school populations, score students as resident individuals if they attend school on a property with an area of observed contamination and the school is within 200 feet of the area of observed contamination. Score teachers at such a school as workers, and not as residents.

- In general, do not expend resources to determine if there is any overlap in student, worker, and resident populations (i.e., do not try to determine where students or workers live).

- Only 5 targets points are assigned for the resources factor. Do not spend significant time documenting resource use unless those 5 points may be critical to the site score.

374

SECTION 9.6 TERRESTRIAL SENSITIVE ENVIRONMENTS

This section provides a method for identifying terrestrial sensitive environments and for calculating the terrestrial sensitive environments factor value in the soil exposure pathway. Definitions of all terrestrial sensitive environments and specific sources of information for identifying terrestrial sensitive environments are provided in Appendix A. Only those areas that meet the definitional criteria for one or more terrestrial sensitive environments listed in HRS Table 5-5 are eligible for evaluation. All terrestrial sensitive environments located partially or wholly on the area of observed contamination are eligible. Because there are no applicable benchmarks for sensitive environments in the soil exposure pathway, they are always considered subject to Level II concentrations.

RELEVANT HRS SECTIONS

Section 5.1	Resident population threat
Section 5.1.3	Targets
Section 5A.3.5	Terrestrial sensitive environments

DEFINITIONS

Area of Observed Contamination: Established based on sampling locations as any of the following:

- Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.

- For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider that entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytic evidence indicates that:

- A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).

- The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).

Terrestrial Sensitive Environment: A terrestrial sensitive environment is defined as any area that meets the criteria listed in HRS Table 5-5. No other areas are considered terrestrial sensitive environments. Appendix A defines each terrestrial sensitive environment and provides sources for identifying terrestrial sensitive environments. Sensitive environments that are eligible to be scored in the soil exposure pathway and their assigned point values are as follows:

- Terrestrial critical habitat for Federal designated endangered or threatened species (100 points);
- National Park (100 points);
- Designated Federal Wilderness Area (100 points);
- National Monument (100 points);
- Terrestrial habitat known to be used by Federal designated or proposed threatened or endangered species (75 points);
- National Preserve (terrestrial) (75 points);
- National or state Wildlife Refuge (terrestrial) (75 points);
- Federal land designated for protection of natural ecosystems (75 points);
- Administratively proposed Federal Wilderness Area (75 points);
- Terrestrial areas utilized for breeding by large or dense aggregations of animals (75 points);
- Terrestrial habitat known to be used by state designated endangered or threatened species (50 points);
- Terrestrial habitat known to be used by species under review as to its Federal designated endangered or threatened status (50 points);
- State lands designated for wildlife or game management (25 points);
- State designated Natural Areas (25 points); and
- Particular areas, relatively small in size, important to maintenance of unique biotic communities (25 points).

SCORING TERRESTRIAL SENSITIVE ENVIRONMENTS

Many terrestrial sensitive environments will be relatively easy to identify and delineate with readily available materials (e.g., maps or EPA Regional files for other sites located near the site being evaluated); more in-depth investigation may be necessary to determine if other types of terrestrial sensitive environments are within the area of observed contamination. The following steps will help identify and score the terrestrial sensitive environments listed in HRS Table 5-5.

(1) **Determine the areas of observed contamination.** See Section 9.1. Determining Level I or Level II concentrations Is not necessary in evaluating terrestrial sensitive environments

(2) **Identify and delineate all eligible terrestrial sensitive environments.** All terrestrial sensitive environments (i.e., those listed in HRS Table 5-5) that are at least partially on an area of observed contamination are eligible. The 200-foot rule for resident populations does not apply to terrestrial sensitive environment targets. Property boundaries are not considered.

- Obtain a USGS topographic map of the area. Maps are available from USGS map stores, most outdoor stores, and local outfitters. Delineate areas of observed contamination on the topographic map.

- Identify terrestrial sensitive environments delineated on the map. The following terrestrial sensitive environments are likely to be found on USGS topographic maps:

376

- — National Park
- — Designated Federal Wilderness Area
- — National Monument
- — National Preserve (terrestrial)
- — National or state terrestrial wildlife refuge
- — State lands designated for wildlife or game management (in some cases).

In many cases, the level of detail provided by USGS maps will be sufficient for HIRS purposes. In other cases, more specialized maps or professional judgment may be needed.

- Obtain additional maps, documents, or other relevant information to determine whether other terrestrial sensitive environments are at least partially on an area of observed contamination. The following sensitive environments may be delineated on specialized maps, charts, or other special documents available from various Federal and state agencies:

  - — Terrestrial critical habitat for Federal designated endangered or threatened species (in some cases);

  - — Federal land designated for the protection of natural ecosystems;

  - — Administratively proposed Federal Wilderness Areas;

  - — State lands designated for wildlife or game management; and

  - — State designated Natural Areas.

  Sources of information on sensitive environments and specific guidance for obtaining specialized maps is provided in Appendix A.

  If all potential terrestrial sensitive environments can be identified and delineated using USGS topographic maps and other specialized maps, no further investigation will be necessary. However, many sensitive environments are not delineated on either USGS or specialized maps, so other sources may need to be consulted.

- Contact appropriate Federal, state, or local agencies if an area not delineated on a map may be a terrestrial sensitive environment. The following terrestrial sensitive environments generally are not delineated on maps or otherwise described in specialized publications.

  - — Terrestrial habitat known to be used by Federal designated or proposed endangered or threatened species;

  - — Terrestrial areas utilized for breeding by large or dense aggregations of animals;

  - — Terrestrial habitat known to be used by state designated endangered or threatened species;

  - — Terrestrial habitat known to be used by species under review as to its Federal endangered or threatened status; and

  - — Particular areas, relatively small in size, important to maintenance of unique biotic communities.

The assistance of appropriate Federal, state, or local agencies or recognized experts in identifying these sensitive environments is encouraged. Try to obtain copies of any published information that helps to establish the area as a sensitive environment and/or delineate its boundaries. If possible, obtain a written statement from a responsible agency official verifying the existence and boundaries of the terrestrial sensitive environments. For guidance on identifying these sensitive environments and on sources of information to delineate these sensitive environments, see Appendix A.

- Draw the boundaries of each terrestrial sensitive environment on the USGS topographic map or a scale map of the site. While this step is optional, it may be helpful in delineating the terrestrial sensitive environments.

(3) **Assign a point value for the terrestrial sensitive environment(s).** Assign the appropriate point value from HRS Table 5-5 to each terrestrial sensitive environment at least partially on an area of observed contamination. If more than one point value applies to a single area of observed contamination, go to Step (4), otherwise go to Step (5).

(4) **If more than one point value applies to a single area of observed contamination:**

- Score each discrete physical area identified as a terrestrial sensitive environment as a separate target for HRS purposes, regardless of the degree of overlap with other terrestrial sensitive environments.

- Treat "critical habitat for" or "habitat known to be used by" endangered or threatened species as follows:

  – Identify at least one distinct habitat for each individual species (e.g., if there are three different species, identify three or more habitats - even if they partially or completely overlap).

  – For each species, assign the category with the highest point value. For example, if the same species is both a Federal proposed threatened species (75 points), and a state designated endangered species (50 points), evaluate the species as a Federal proposed threatened species.

  – If there is overlap between "critical habitat for" and "habitat known to be used by" the same species, consider the overlapping area to be only a "critical habitat" for HRS purposes (i.e., do not consider the zone of overlap as both "critical habitat for" and "habitat used by" the species).

(5) **Calculate the total targets value for terrestrial sensitive environments.** Because only those terrestrial sensitive environments wholly or partially on an area of actual contamination are evaluated as targets in the soil exposure pathway, and no ecological-based benchmarks are used, do not evaluate levels of concentrations for terrestrial sensitive environments in the soil exposure pathway. To obtain the total targets value for sensitive environments (ES), sum assigned point values for all terrestrial sensitive environments wholly or partially on an area of actual contamination.

(6) **Calculate the terrestrial sensitive environments factor value.** Because the soil exposure pathway score based solely on terrestrial sensitive environments is limited to 60 points, the method for determining the terrestrial sensitive environments factor value depends on the total targets value for sensitive environments (ES - calculated in Step (5) above), the likelihood of exposure value for the resident population threat (LE - 550 points for the resident population threat), and the waste characteristics value for the resident population threat (waste characteristics (WC) - see Section 9.2).

- Multiply the values assigned to the resident population threat for LE, WC, and ES and divide this product by 82,500.

$$S = \frac{(LE)(WC)(ES)}{82,500}$$

- If the resulting score (S) is 60 or less, assign ES as the terrestrial sensitive environments factor value.

- If the resulting score (S) is greater than 60, assign only that portion of ES that will result in a resident population threat score of 60 as the terrestrial sensitive environments factor value. This value, termed EC, is calculated as follows:

$$EC = \frac{(60)(82,500)}{(LE)(WC)} = \frac{4,950,000}{(LE)(WC)}$$

Since all the values in this equation are constants except WC, only one EC value corresponds to each WC value. These values are presented in *Highlight 9-15.* Do not round EC to the nearest integer.

Highlight 9-16 illustrates how to score terrestrial sensitive environments.

(7) **The value calculated In Step (6) (either ES or EC) Is added to the values for resident individual, resident population, workers, and resources, to calculate the total targets score.**


HIGHLIGHT 9-15
EC VALUES CORRESPONDING TO
WASTE CHARACTERISTICS FACTOR VALUES

Because the soil exposure pathway score based solely on terrestrial sensitive environments is limited to 60 points, the product of the likelihood of exposure (LE), waste characteristics (WC), and sensitive environments (ES) divided by 82,500 cannot exceed 60. If this value does exceed 60, the scorer calculates the maximum value for sensitive environments that will not exceed 60. (I.e., the value of EC). Because all the values in this equation for calculating EC are constants except WC, there is only one EC value associated with each WC factor value.

Waste Characteristics Factor Value	EC Value
1	9000
2	4500
3	3000
6	1500
10	900
18	500
32	281.25
56	160.71
100	90

Section 9.6

HIGHLIGHT 9-16
SCORING EXAMPLE FOR TERRESTRIAL SENSITIVE ENVIRONMENTS
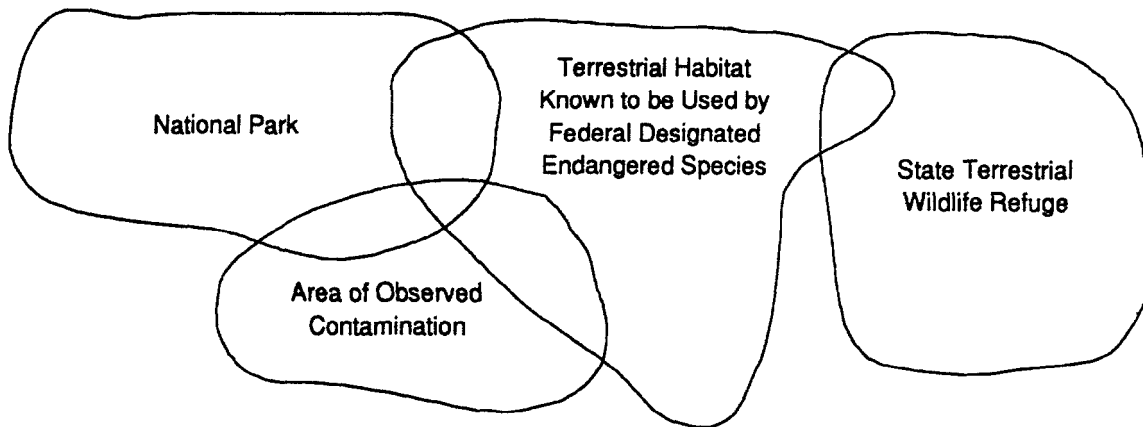
At this site, the area of observed contamination has been determined, the assigned value for likelihood of exposure (LE) is 550, and the assigned value for waste characteristics (WC) is 100. Three terrestrial sensitive environments are identified and delineated as shown.

- The National Park and the terrestrial habitat known to be used by a Federal endangered species are identified as eligible to be evaluated in the soil exposure pathway because each is partially on the area of observed contamination. The state terrestrial wildlife refuge is not eligible because it is not partially within the area of observed contamination.

- The National Park is assigned a point value of 100 from HRS Table 5-5 and the habitat known to be used by the endangered species is assigned a point value of 75 from HRS Table 5-5.

- The total targets value for sensitive environments (ES) is determined by summing the assigned point values for the National Park and the habitat known to be used by the endangered species (i.e., 100 + 75 = 175).

- The terrestrial sensitive environments factor value is determined as follows:

  — The values for LE, WC, and ES are multiplied and divided by 82,500 to obtain the score (S) of 116.67.

  — Because 116.67 is greater than 60, the value EC = 90 is calculated by dividing (60 x 82,500) by (LE x WC).
  EC = 4,950,000/55,000 = 90

  — The terrestrial sensitive environments factor was assigned a value of 90 (i.e., EC).

TIPS AND REMINDERS

- The 200-foot rule for resident populations does not apply to sensitive environment targets. Sensitive environments must be listed in HRS Table 5-5 and be at least partially on the area of observed contamination to be evaluated as a terrestrial sensitive environment in the soil exposure pathway.

- If overlapping sensitive environments (i.e., those listed in HRS Table 5-5) are at least partially on an area of observed contamination, evaluate each sensitive environment separately, with certain restrictions for habitats of endangered or threatened species.

- The sensitive environment category "wetland" is not evaluated in the soil exposure pathway. However, portions of wetlands that are periodically out of water and that meet the criteria for one or more terrestrial sensitive environment categories may be evaluated as that type of sensitive environment.

- Terrestrial sensitive environments are evaluated only in the resident population threat, not in the nearby population threat.

SECTION 9.7
ESTIMATION OF
NEARBY POPULATION
THREAT SCORES

LR   WC   T

This section is designed to estimate the maximum score that can be expected from the nearby population threat of the soil exposure pathway before beginning the detailed scoring process. This section presents general formulae and took-up tables that provide estimates of nearby population threat scores. Section 9.8 provides guidance on scoring the nearby population threat. Because the nearby population threat evaluates only non-residents and students coming onsite, nearby population threat scores tend to be low. Therefore, sites must be relatively accessible and attractive, with a fairly large nearby population, to obtain a significant score or to warrant detailed scoring of the threat. This section provides guidance for estimating nearby population, the area of observed contamination, and the maximum expected nearby population threat score. This section is intended as a general guideline and should not be used to determine whether nearby population threat should be scored.

DEFINITIONS

Nearby Population: Total number of people who live or attend school within a 1 -mile travel distance of an area of observed contamination and who do not meet the criteria for resident individual.

Resident Individual: A person who lives or attends school or day care on a property with an area of observed contamination and whose residence, school, or day care center, respectively, is on or within 200 feet of the area of observed contamination. Section 9.3 provides guidance for identifying resident individuals.

ESTIMATING NEARBY POPULATION THREAT SCORE

Follow these steps to quickly determine if detailed scoring and documentation of the nearby population threat is warranted.

(1)   **Estimate nearby population**. Estimate nearby population using one of the following three approaches:

   •   In the first method, if nearby population data are readily available for each of the three travel distance categories (i.e., >0 to 1/4 mile, >1/4 to 1/2 mile, >1/2 to 1 mile), determine the distance-weighted population value from HRS Table 5-10.

   •   In the second method, nearby population data are not readily available, obtain a recent estimate of population density in the vicinity of the site and use this estimate to approximate nearby population (see *Highlight 9-17*). Assume that the travel distance categories are delineated by concentric circles around the areas of observed contamination and that the local population is evenly distributed within the TDL. If information suggests otherwise (e.g., no one lives within 1/2 mile of the site), adjust the estimate of nearby population.

HIGHLIGHT 9-17
APPROXIMATE DISTANCE-WEIGHTED POPULATION
VALUES BASED ON LOCAL POPULATION DENSITY (D)[a]

Approximate Dimension of Area of Observed Contamination	Travel Distance Category	Approximate Population [b,c]
1.8 acres	>0 to 1/4 >1/4 to 1/2 >1/2 to 1	0.2 x D 0.6 x D 2.4 x D
126 acres	>0 to 1/4 >1/4 to 1/2 >1/2 to 1	0.6 x D 1.0 x D 3.1 x D
3.2 square miles	>0 to 1/4 >1/4 to 1/2 >1/2 to 1	1.8 x D 2.2 x D 5.5 x D

[a] D = local population density (people per square mile).
[b] Formulas assume concentric travel distance categories.
[c] See HRS Table 5-10 to determine the approximate distance-weighted population value.

- In the third method, if local population density cannot be readily estimated, estimate population density based on whether the site is located in an urban, suburban, or rural area. Typically population densities (people per square mile) for these areas are as follows: 5,100 (large urban area), 1,300 (suburban or urban in small city), 300 (rural).

(2) **Determine the approximate maximum nearby threat score assuming maximum values for waste characteristics and likelihood of exposure.** To determine an approximate upper-bound limit for the nearby population threat score, assume the maximum waste characteristics factor category value (i.e., 100) and the maximum likelihood of exposure factor category value (i.e.**,** 500).

- If an approximate distance-weighted population value is obtained using methods 1 or 2 under Step (1), determine the approximate maximum nearby population threat score by multiplying the result by 0.061 (i.e., (100 x 500)/82,500).

- If a nearby population is estimated using method 3 under Step (1), *Highlight 9-18* can be used to estimate maximum nearby population threat score (*Highlight 9-18* also assumes concentric travel distance categories and an evenly distributed population).

Highlight 9-18 can also be used to determine a range of maximum nearby population threat scores when population density data are available from method 2 under Step (1). From the population density data, area of observed contamination, and likelihood of exposure factor, estimate the maximum nearby population threat score. For example, for a medium site with maximum values for likelihood of exposure and waste characteristics factor categories, and a population density of 2,500 people per square mile, the maximum nearby population threat score is between 4 and 13.

If the approximate maximum nearby threat scores suggest that it may be worthwhile to score the nearby population threat, proceed to Step (3).

HIGHLIGHT 9-18
APPROXIMATE NEARBY POPULATION THREAT SCORES [a]

Area of Observed Contamination	Likelihood of Exposure	Population Density (people per square mile)						
		50	100	500	1,000	5,000	10,000	50,000
1.8 acres	500	1	1	1	2	9	13	83
	375	1	1	1	1	7	10	62
	250	0	0	1	1	4	7	41
	125	0	0	0	1	2	3	21
	50	0	0	0	0	1	1	8
	25	0	0	0	0	0	1	4
	5	0	0	0	0	0	0	1
126 acres	500	1	1	2	4	13	32	100
	375	1	1	1	3	10	24	95
	250	0	0	1	2	7	16	63
	125	0	0	0	1	3	8	32
	50	0	0	0	0	1	3	13
	25	0	0	0	0	1	2	6
	5	0	0	0	0	0	0	1
3.2 square miles	500	1	1	3	6	27	58	100
	375	1	1	2	5	20	43	100
	250	0	1	2	3	14	29	100
	125	0	0	1	2	7	14	66
	50	0	0	0	1	3	6	26
	25	0	0	0	0	1	3	13
	5	0	0	0	0	0	1	3

[a] The scores presented in this table assume a waste characteristics factor category value of 100, nearby individual factor value equal to one, concentric travel distance categories, and uniformly distributed population (see text). Also, these values reflect the nearby population threat's overall effect on the soil exposure pathway score (i.e., they are divided by 82,500).

(3)   **Determine the approximate maximum nearby population threat score assuming maximum value for waste characteristics**. If the maximum approximate nearby population threat score suggests that it may be worthwhile to score the nearby population threat, obtain a more realistic upper bound on the nearby population threat score by estimating likelihood of exposure (and continuing to assume maximum waste characteristics). The likelihood of exposure factor category value is based on area of contamination and attractiveness/accessibility.

- Determine the approximate area of observed contamination. If the area of contamination is known or can easily be determined or estimated (e.g., areas of observed contamination are limited to surface impoundments or other areas with known dimensions), determine the area of contamination factor value using HRS Table 5-7. If the area of contamination is less apparent, use *Highlight 9-19* to determine the area of contamination factor value that best approximates the maximum size of the area(s) of observed contamination for the site.

- Determine the approximate maximum attractiveness/accessibility factor value. If any area of observed contamination is within a designated recreational area, national park, or other similar area, assign an attractiveness/accessibility factor value of 100. Otherwise, assume an attractiveness/accessibility factor value of 75.

- Estimate likelihood of exposure. Use the estimated area of contamination factor value and the estimated attractiveness/accessibility factor value to approximate the likelihood of exposure factor category value, using *Highlight 9-20*.

- Determine the approximate nearby population threat score. From *Highlight 9-18*, estimate the approximate nearby population threat score using the estimate for the likelihood of exposure factor category. Remember that this step still assumes a waste characteristics factor value equal to 100. Score the nearby population threat only if this approximate nearby population threat score suggests that it is worth proceeding further. To actually score the nearby population threat, follow HRS section 5.2 and Section 9.8.

HIGHLIGHT 9-19
## ESTIMATED AREA OF CONTAMINATION FACTOR VALUES

Assigned Factor Value for Area of Contamination	Minimum Area of Contamination Needed to Score Factor Value (square feet)	Diameter of Contaminated Circular Area Needed to Achieve Value (feet)
5	>0	>0
20	>5,000	80
40	>125,000	400
60	>250,000	565
80	>375,000	690
100	>500,000	800

HIGHLIGHT 9-20
ESTIMATED NEARBY POPULATION LIKELIHOOD OF EXPOSURE FACTOR VALUES

Attractiveness/ accessibility Factor Value	Area of Contamination Factor Value					
	100	80	60	40	20	5
100	500	500	375	250	125	50
75	500	375	250	125	50	25

Section 9.7

SECTION 9.8
EVALUATION OF NEARBY
POPULATION THREAT
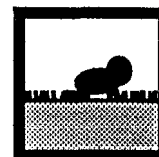
This section provides guidance for scoring the nearby population threat of the soil exposure pathway. The nearby population threat targets factor category reflects the non-resident population potentially at risk from exposure to contaminated soil or other contaminated surficial materials. This section provides instruction for scoring the likelihood of exposure, waste characteristics, and targets factor categories. In addition, this section clarifies how to determine travel distance.

RELEVANT HRS SECTIONS

Section 5.0.1	General considerations
Section 5.2	Nearby population threat
Section 5.2.1.1	Attractiveness/accessibility
Section 5.2.1.2	Area of contamination
Section 5.2.3	Targets

DEFINITIONS

Nearby Individual: Resident or student with the shortest travel distance to any area of observed contamination. If one or more individuals meet the criteria for resident individual, the nearby individual factor value is zero.

Nearby Population: Total number of people who live or attend school within a 1-mile travel distance of an area of observed contamination and who do not meet the criteria for resident individual.

Public Recreation Area: Publicly or privately owned area used for recreation by individuals not evaluated as workers in the resident population threat.

Resident Individual: A person who lives or attends school or day care on a property with an area of observed contamination and whose residence, school, or day care center, respectively, is on or within 200 feet of the area of observed contamination. Section 9.3 provides guidance for identifying resident individuals.

Travel Distance: The shortest overland distance an individual would travel from a residence or school to the nearest area of observed contamination, considering natural barriers (e.g., ravines, streams). If there are no natural barriers, the travel distance is the shortest straight-line distance.

SCORING THE LIKELIHOOD OF EXPOSURE FACTOR CATEGORY

To score the likelihood of exposure factor category for the nearby population threat, determine the attractiveness/accessibility factor value and the area of contamination factor value for the areas of observed contamination as follows.

(1)   **Assign the attractiveness/accessibility factor value.** Assign each area of observed contamination a value for attractiveness/accessibility, excluding any area of observed contamination on a residential property. If an area falls into two or more categories, use the higher score. Select the highest value assigned to the areas evaluated and use it as the attractiveness/accessibility factor value for the site. If the attractiveness/accessibility factor value for a site is 0, the nearby population threat score will be 0.

> *Highlight 9-21*, which is based on HRS Table 5-6, provides attractiveness/accessibility factor values along with examples of the types of areas that would receive a given value. Public recreation use can be activities such as walking, sports, fishing, air shows, and hayrides, and can occur on public or private lands. The examples presented in *Highlight 9-21* are not exhaustive. Select the best-fitting category and document why it was selected.

(2)   **Determine the area of contamination factor value.** The area of contamination factor value is based on the total area of all areas of observed contamination at the site with an attractiveness/accessibility factor value greater than 0. To determine the area of contamination factor value:

- Identify all areas of observed contamination with an attractiveness/accessibility value greater than 0.

- Determine their total area.

- Assign the approximate area of contamination factor value using HRS Table 5-7.

Section 9.1 provides instruction on identifying areas of observed contamination.

(3)   **Determine the likelihood of exposure factor category value.** The likelihood of exposure factor category value is based on the values assigned to the attractiveness/accessibility and area of contamination factors. Use HRS Table 5-8 to assign this value. The maximum value is 500.

SCORING WASTE CHARACTERISTICS FACTOR CATEGORY

The waste characteristics factor category for the nearby population threat is scored as it is scored for the resident population threat, except that the nearby threat considers only those areas of observed contamination that have an attractiveness/accessibility factor value greater than 0. The waste characteristic factor category value for the nearby population threat, therefore, will be equal to or less than that for the resident population threat. Section 9.2 provides guidance on scoring the waste characteristics factor.

SCORING TARGETS FACTOR CATEGORY

The targets factor category value for the nearby population threat is based on two factors: nearby individual and population within a one-mile travel distance from the site. Sum these two factor values for the targets factor category value.

HIGHLIGHT 9-21
EXAMPLES OF ATTRACTIVENESS/ACCESSIBILITY VALUES

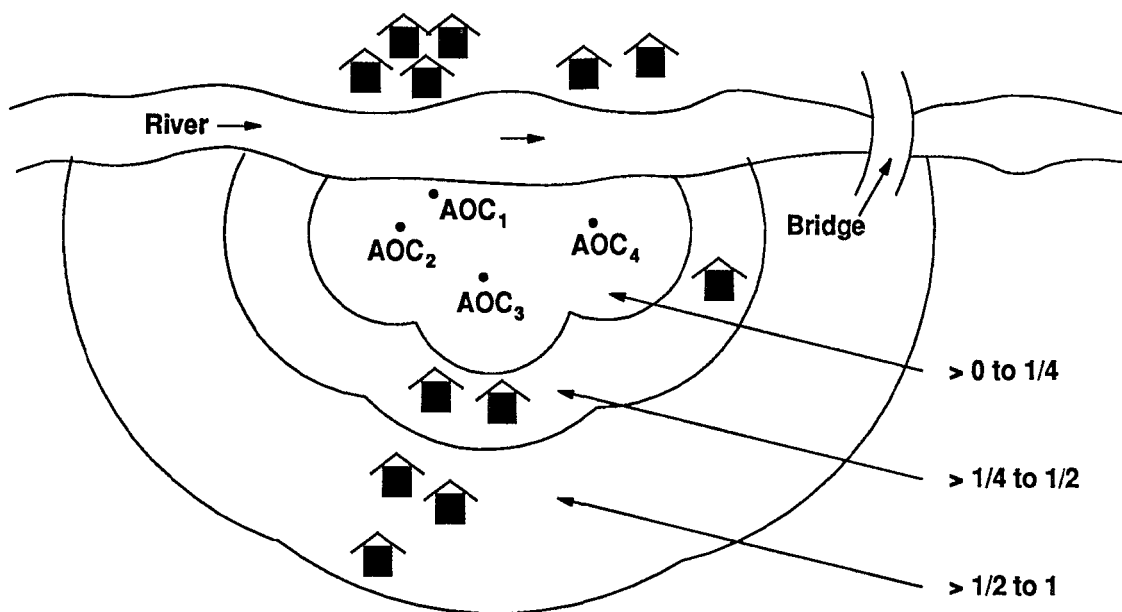| Area of Observed Contamination	Assigned Value
Designated recreational areas Includes areas designed specifically to encourage recreational use. • Playground • Golf course (public or private) • Baseball field with backstop and maintained basepaths or infield • Areas with Improvements aimed at enabling people to view scenic attractions	100
Areas regularly used for public recreation Includes areas used regularly for public recreation but not designated for such use. • Open fields where people play frisbee • Fields where people play baseball (provided that they are not maintained for such use)	75
Accessible and unique recreational areas • Vacant lot in an urban area • Shoreline of stream in an urban area	75
Moderately accessible areas with some public recreation use Includes areas used for recreation with some Improvements that increase accessibility even if these improvements are not made specifically for the areas In question. • Undeveloped land along corridors to a recreational area where there are not thousands of acres of similarly undeveloped land (e.g., areas adjacent to a road or trail leading to a public lake or river) • Shoreline of public lakes or rivers that can be reached via moderately improved roads (e.g., gravel or dirt)	50
Slightly accessible areas with some public recreation use Includes areas used for public recreation but with few improvements that increase accessibility to the areas. It can also include areas that have nothing unique about them relative to their surroundings. • Shorelines of relatively remote public lakes (e.g., lakes that cannot be reached by automobile) • Undeveloped land along corridors to a recreational area where there are thousands of other acres of similarly undeveloped land along the corridor	25
Accessible areas with no public recreation use • Unfenced industrial or commercial site (guarded or not) with no vacant lots, sand piles, or other recreational attractions • Abandoned lagoons or other surface impoundments in an industrial area	10
Areas surrounded by maintained fence or combination of maintained fence and natural barriers • Fenced, unguarded industrial or commercial sites	5
Areas physically Inaccessible to public, with no evidence of public recreation use Includes areas where (1) steps have been taken to absolutely preclude public access to the areas or (2) natural conditions make access physically impossible. • Area off-limits to unauthorized personnel at guarded and fenced military base or industrial complexes.	0

(1)   **Determine the nearby Individual factor value.** Determine the nearby individual factor value as follows:

  •   If one or more persons meet the criteria for resident individual (as specified in HRS section 5.1.3 and Section 9.4), assign a value of 0 for the nearby individual factor.

  •   If no person meets the criteria for a resident individual, determine the shortest travel distance from the site to any residence or school. The travel distance is the shortest overland distance an individual would travel from a residence or school to the nearest area of observed contamination for the site with an attractiveness/accessibility factor value greater than 0.

    —   If there are no natural barriers to travel, measure the travel distance as the shortest straight-line distance from the residence or school to the area of observed contamination.

    —   If natural barriers exist (e.g., a river, a ravine), measure the travel distance as the shortest distance that a person would be expected to travel to get from the residence or school to the area of observed contamination, assuming the person avoided these barriers (e.g., did not wade the stream or scale the ravine).

  •   If the travel distance of the nearby individual is less than or equal to 1/4 mile, the nearby individual factor value is 1; otherwise, this factor value is 0.

(2)   **Determine the population within 1 mile.** To score the population within 1 mile, determine the population within each travel distance category (i.e., >0 to 1/4 mile, >1/4 to 1/2 mile, >1/2 to 1 mile).

  •   Count residents and students who attend school within this travel distance. Do not include those people already counted in the resident population threat (except for individuals evaluated as workers in the resident population threat who are not also resident individuals and who live within a one-mile travel distance).

  •   Determine travel distances for the population within one mile as specified for the nearby individual (i.e., determine the approximate travel distance from each residence and school to the area of observed contamination; do not simply draw distance rings unless there is only one area of observed contamination and there are no natural or constructed barriers).

  •   For sites with multiple areas of observed contamination, two methods are generally used to determine a representative score for populations within one mile for the nearby threat.

    —   In the first method (see *Highlight 9-22*), draw travel distance categories around each area of observed contamination (however, do not draw distance categories across natural barriers), determine aggregate travel distance categories (e.g., make overlapping rings of the same travel distance one travel distance category), and total the population within each travel distance category. The total population is then used to determine the factor value assigned for population within one mile. Assign each individual to the travel distance category nearest to an area of observed contamination (e.g., an individual within one-quarter mile of one area of observed contamination and one-half mile of another area of observed contamination is counted only in the zero to one-quarter mile distance category). Also, count individuals only once, except for individuals who are both residents and students.

HIGHLIGHT 9-22
ESTABLISHING TARGET DISTANCE CATEGORIES
FOR NEARBY THREAT: METHOD 1

River →

AOC_1
AOC_2
AOC_4
AOC_3

Bridge

> 0 to 1/4

> 1/4 to 1/2

> 1/2 to 1

= Residence

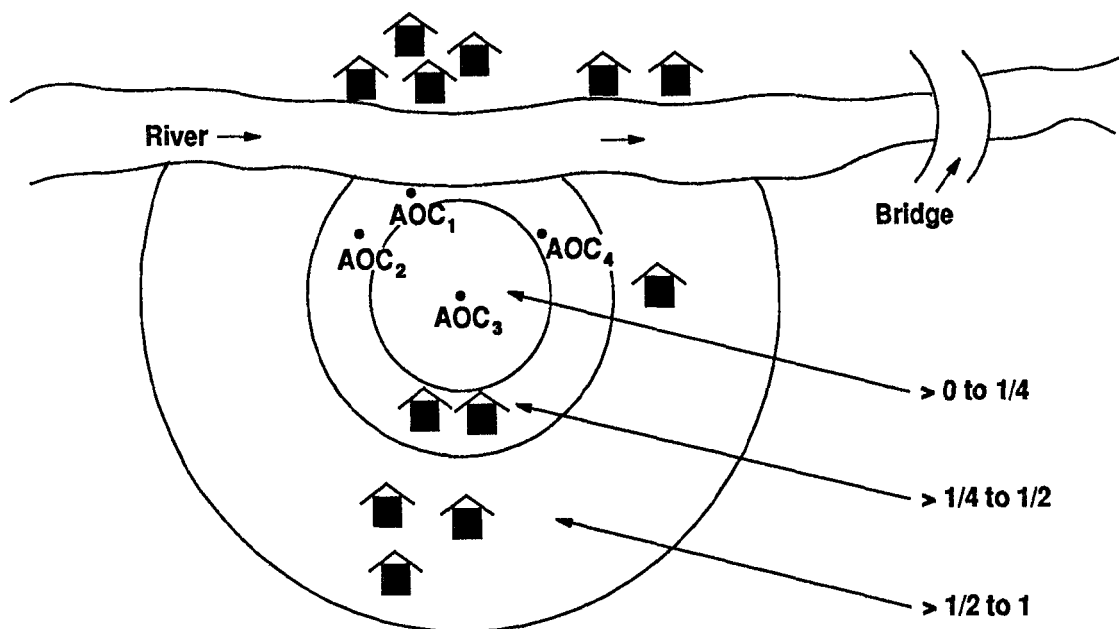AOC_x = Area of observed contamination

- Each sample location establishes an area of observed contamination. Due to site-specific conditions, it is not appropriate to connect the points into one area of observed contamination.

- Draw travel distance categories from each area of observed contamination and then aggregate travel distance categories.

- Sum the population within each travel distance category (excluding those counted in the resident population) to determine the total population within each travel distance category. From HRS Table 5-10, determine the population within one mile factor value.

- If no individual qualifies as a resident individual, use the resident nearest an area of observed contamination to determine the nearby individual factor value.

- Do not include residences on the far side of the river, even though they are within one mile in straight-line distance, because they are not within a one-mile travel distance of the area of observed contamination.

- This method may be unwieldy for sites with many areas of observed contamination.

— At sites with a large number of areas of contamination, this method may be time-consuming and inefficient. Because factor values are assigned based on population ranges within each travel distance category, a simplified method may be used with little or no impact on the threat source.

— In the second method (see *Highlight 9-23*), rather than calculate the population within one mile for all areas of contamination, determine which area(s) of observed contamination will give the highest score for the site based on travel distances to populations and population densities. Draw travel distance categories only for these areas of contamination. This method is most effective for sites with a large number of areas of contamination, and for sites with large population densities, but it may underestimate target scores.

- When the number of residences within a travel distance category are used to estimate the population, multiply each residence by the average number of people per residence for the county in which the residence is located.

- When the number of people within each travel distance have been determined, assign the appropriate distance-weighted population value for that travel distance from HRS Table 5-10. Sum these distance-weighted population values and divide the total by ten. If this number is less than one, do not round it to the nearest integer; otherwise, round to the nearest integer. This value is the population within one-mile factor value.

(3) **Determine the nearby population targets factor category value.** Sum the values for the nearby individual factor and the population within one mile factor. This sum is the targets factor category value for the nearby population threat.

CALCULATING THE NEARBY POPULATION THREAT SCORE

To assign a score to the nearby population threat, multiply the values for likelihood of exposure, waste characteristics, and targets for the nearby population threat, and round the product to the nearest integer. Assign this product as the nearby population threat score.

HIGHLIGHT 9-23
ESTABLISHING TARGET DISTANCE CATEGORIES
FOR NEARBY THREAT: METHOD 2

River →

AOC$_1$
AOC$_2$
AOC$_4$
AOC$_3$

Bridge

> 0 to 1/4

> 1/4 to 1/2

> 1/2 to 1

= Residence

AOC$_x$ = Area of observed contamination

- Each sample location establishes an area of observed contamination. Due to site-specific conditions, it is not appropriate to connect the points into one area of observed contamination.

- Decide which area(s) of observed contamination will likely give the most representative HRS score, and then draw travel distance categories from only those areas of observed contamination.

- Sum the population for each travel distance category and calculate the population within one mile factor value from HRS Table 5-10.

- If no individual qualifies as a resident, use the resident nearest an area of observed contamination to determine the nearby individual factor value.

- Do not include residences on the far side of the river, even though they are within one mile in straight-line distance, because they are not within a one-mile travel distance of the area of observed contamination.

- This method may underestimate target scores in some instances, but it may simplify efforts at sites with many areas of observed contamination or dense populations, with little or no impact on the threat score.

TIPS AND REMINDERS

•   Do not include in the nearby population individuals evaluated as resident individuals.

•   Include in the nearby population individuals evaluated as workers for the resident population threat who are not resident individuals but live within a one-mile travel distance.

•   Assign 0 as the nearby individual factor value if one or more persons meet the criteria for resident individual.

•   Evaluate travel distance based on the shortest distance a person would be expected to travel, given existing natural barriers, which may not be the straight-line distance.

•   Evaluate only areas of contamination with an attractiveness/accessibility factor value greater than 0 in the nearby population threat.

•   When population estimates are based on number of residences, multiply by average number of persons per residence for the county.